Novel Application of an Intermediate Sized Bridging Catheter as an Adjunct to Aneurysm Coiling in Patients with Tortuous Vasculature

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Summary

Selective microcatheterization of intracranial aneurysms during coiling can be limited by tortuous vasculature. Stabilization of the microcatheter via distal placement of the guide catheter in the intracranial vasculature may cause vessel dissection or vasospasm. We describe the application of an intermediate sized bridging catheter in four patients with tortuous vasculature who underwent successful coiling of ruptured aneurysms. No complications occurred. The intermediate sized bridging catheter is a useful adjunct for navigation of tortuous parent artery vasculature.

Introduction

Neuroendovascular procedures rely on the ability of the interventionalist to effectively navigate and support a microcatheter in a given position at a particular location. Despite technological advances in microcatheter design, tortuous vascular anatomy may prevent selective catheterization of an intracranial aneurysm or contribute to microcatheter instability. Increased relative distance between the guide catheter and the target lesion may render the catheter construct unstable, thereby elevating the risk of selective catheterization and/or contributing to imprecise coil deployment.

Tri-axial catheter systems (i.e. the use of an intermediate sized "bridging" catheter between the guide and microcatheters) may effectively stabilize the microcatheter, allowing for selective catheterization of target lesions in the setting of significant vessel tortuosity. The Outreach™ distal access catheter (DAC, Concentric Medical, Mountain View, CA, USA) is a small diameter (3.3-Fr inner and 4.3-Fr outer diameters, respectively) catheter that is capable of navigating tortuous vessel anatomy (Figure 1). It was designed for use in conjunction with the MERCI™ device (Concentric Medical, Mountain View, CA, USA) as its physical characteristics provide increased support and decreased deflection during clot retrieval. The distal access catheter (DAC) has a stainless steel braided construction which may prevent kinking and a PTFE (polytetrafluoroethylene) liner that was designed to reduce internal friction when used in combination with the MERCI™ device. We describe a novel application of the DAC used as an intermediate sized bridging catheter to aid ruptured intracranial aneurysm embolization in four patients whose tortuous arterial anatomy made initial attempts at selective microcatheterization difficult. In all cases, the DAC was used to bridge the guide catheter to the microcatheter in a triaxial system that effectively enhanced our ability to coil the aneurysms.

Illustrative Cases

Case 1

A 63-year-old woman was admitted with complaints of photophobia and headaches (Hunt-Hess Grade I) stemming from a ruptured left posterior inferior cerebellar artery

(PICA) aneurysm (3 x 4 x 6 mm) immediately distal to the origin of the left PICA. After gaining transfemoral access, a 6-Fr Envoy guide catheter (Codman Neurovascular, Raynham, MA, USA) was docked in the proximal left vertebral artery. Several attempts were made at positioning a microcatheter into the aneurysm neck without success due to significant tortuosity of the patient's left vertebral artery. The DAC was placed over a Synchro-2 microwire and Excelsior 1018 microcatheter (Boston Scientific, Fremont, CA, USA). This construct was advanced, and the intermediate bridging catheter was docked in the proximal intracranial segment of left vertebral artery. The aneurysm neck was then effectively catheterized using the microwire and microcatheter (Figure 2). The aneurysm was completely coiled (100% obliteration). No procedural complications occurred, and the patient was discharged home on post-SAH day 14 (post-coil day 13).

Case 4

A 51-year-old woman presented neurologically intact (Hunt-Hess Grade I) with a subarachnoid hemorrhage from a ruptured anterior communicating artery (ACOM) aneurysm (2.4 x 5.5 x 10.3 mm) filling via a right dominant A1 anterior cerebral artery segment. The patient was taken to the angiography suite for coiling. Attempts at selectively catheterizing the neck of the aneurysm were unsuccessful due to proximal common carotid artery tortuosity and flow-limiting vasospasm encountered in the distal extracranial and proximal intracranial segments of the right internal carotid artery (ICA) immediately following placement of the 6-Fr Envoy guide catheter (Codman Neurovascular, Raynham, MA, USA) into the mid-cervical ICA (Figure 3A). The vasospasm resolved after withdrawal of the guide catheter and injection of 10 mg of intra-arterial verapamil into the right ICA over 45 minutes without significant alteration in hemodynamic parameters. To avoid vasospasm recurrence, the guide catheter was docked at the ICA origin and a triaxial construct was used to selectively catheterize the target lesion. The DAC was introduced over a Prowler 14 microcatheter (Codman Neurovascular, Raynham, MA, USA) and Synchro-2 microwire (Boston Scientific, Fremont, CA, USA). This construct was then advanced in the ICA, and the DAC was parked in the right ICA petro-cavernous junction. A small amount of kickback was encountered upon selective microcatheterization of the aneurysm, causing the intermediate sized bridging catheter to migrate into the mid-petrous segment of the ICA (Figure 3B). The aneurysm was successfully embolized (95% obliteration), leaving only a small neck remnant (Figure 3C). No further vasospasm was encountered. No procedural complications occurred, and the patient was discharged home neurologically intact on post-SAH day 15 (post-coil day 14).

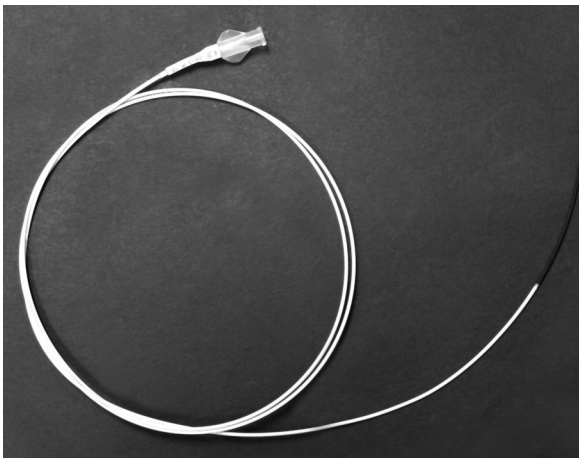

Figure 1 The Outreach™ distal access catheter (Concentric Medical, Mountain View, CA, USA).

Discussion

Stabilization of the microcatheter during coiling is essential for safe and effective intracranial aneurysm embolization. Transfemoral access to treat intracranial vascular lesions may be limited by aorto-iliac disease, ectasia of the aorta and/or supra-aortic vessels and tortuous intracranial vascular anatomy. Navigation of tortuous cervical and intracranial arterial anatomy using a microcatheter causes increased tension in the guide catheter, and decreased one-to-one responsiveness in the microcatheter. Either of these phenomenons may obviate selective catheterization of the target lesion. Alternative access to the arterial circulation through transcarotid [1,2], transbrachial [3], or transradial [4-7] approaches may aid in the navigation of tortuous intracranial arterial anatomy or severe atherosclerosis. These approaches carry unique potential complications and patient risks.


A
B
C
D

Figure 3 A) Lateral digital subtraction angiogram (DSA) illustrating flow-limiting vasospasm of the distal extracranial and proximal intracranial segments of the right ICA following attempted selective catheterization of the ACOM aneurysm using a guide and microcatheter construct. B) Lateral DSA showing vasospasm resolution following administration of intra-arterial verapamil. The intermediate sized bridging catheter (arrow) was successfully docked in the mid-petrous segment of the right ICA allowing for microcatheterization of the ACOM aneurysm. C) Final lateral DSA revealing 95% embolization of the ACOM aneurysm.

Figure 2 A) A/P digital subtraction angiogram (DSA) showing placement of the intermediate sized bridging catheter (arrow) in the proximal intracranial segment of the left vertebral artery allowing for selective microcatheterization of the left PICA aneurysm. B) Lateral DSA illustrating placement of the intermediate sized bridging catheter (arrow) in the proximal intracranial left vertebral artery. Note the significant amount of parent artery tortuosity involving the distal extracranial left vertebral artery. Final A/P (C) and lateral (D) DSA revealing 100% aneurysm embolization with good filling of the left PICA and basilar artery.

Table 1 **Patient demographic information and aneurysm characteristics.**

Patient	Age	Sex	Aneurysm Location	Rupture Status	Vascular Access	% Coil Embolization	Procedural Complications
1	63	F	Left PICA	Ruptured	Transfemoral	100%	None
2	49	F	Right PICA	Ruptured	Transfemoral	> 90%	None
3	58	F	ACOM	Ruptured	Transfemoral	> 90%	None
4	51	F	ACOM	Ruptured	Transfemoral	95%	None

Innovations in catheter design have improved navigability of tortuous vasculature and microcatheter stability. Park et al. used the 6-Fr Neuron delivery catheter (Penumbra Inc., San Leandro, CA, USA) to successfully treat various intracranial lesions in seven patients deemed to have tortuous supra-aortic, intracranial, or extracranial anatomy[8]. In six cases, the guide catheter was placed in the petrous internal carotid artery or more distally. No complications related to catheter positioning were observed.

In addition to the Outreach™ DAC, other catheters exist that could be used in a triaxial construct. The Tracker 38 catheter (Boston Scientific, Fremont, CA, USA) was an example of an intermediary catheter that provided increased catheter construct stability. However, this device is no longer commercially available. The 0.041 inch Penumbra Reperfusion catheter (Penumbra, San Leandro, CA, USA) can be used in a tri-axial construct to provide increased microcatheter support for treatment of distal lesions. To date, no publications exist reviewing the use of these technologies for this application, but anecdotal reports suggest comparable results.

This observational study has several limitations. Besides having a small number of patients, no rigid selection criteria or controls were established. No attempts at obtaining arterial access through alternative routes were employed that may have potentially allowed for effective navigation of the patients' tortuous vasculature. The intermediate sized bridging catheter effectively stabilized the microcatheter in all cases during aneurysm coiling. No complications were observed. Utilization of bridging catheters appears to be a valuable addition to the ever-expanding neurointerventional armamentarium.

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